



FIELD REPORT: SCAP Is Sea Level Rising?

PIs

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Research site / region

Research Site - Fort Pulaski National Monument, Tybee Island, GA

Country

United States

Date field report completed

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Period covered

June 26th 2010 to July 10th 2010

Report completed by

Candace Grand Pre

Hello SCAP students!

Thank you so much for your fantastic efforts this summer in Savannah, Georgia. I hope that you got everything out of the experience that you were hoping - perhaps even more. We enjoyed our time with you and remember fondly the times we first learned how to pull each other out of the mud, jumping (sometimes not successfully!) across muddy channels, learning to core, laughing, and most importantly when everyone started to understand what we were doing each day and how important the work was for us and for society. You all were part of a very gifted group, all in unique ways, and don't forget that when you move on to whatever you pursue after high school graduation.

I hope that you can confidently answer the question "Is Sea Level Rising?" and perhaps even convey some of the complexities of that seemingly obvious question to your peers, parents, and teachers. You saw first-hand that sea level rise is potentially one of the most devastating impacts of future climate change, but it is not too late to turn that around.

With your help collecting surface and fossil data we will be able to define former sea levels along the coastline using high-resolution geological indicators and validate that data against tide gauges and historical evidence of coastal change. We will then be able to reconstruct sea level rise over the last ~500 years and evaluate the evidence for accelerations that may be linked with human activities.

Over our two week long adventure you participated in every step of the scientific process and are now capable to work along scientists in the field to collect data, make interpretations, and to think critically about complex, multi-variable problems. Most importantly, WE FOUND PEAT! That was certainly the highlight of my trip -- finally, with less than a week left, we found what we were looking for and everyone became so excited. You had a very powerful reaction because you had learned what it meant to find peat both at the top and the bottom of our cores. If I showed you peat the first day of the trip I am sure it would not have caused you to scream with joy, dance, and celebrate like you did the last week! :-) It all came together - the hard work, sweat, and frustrations paid off with finding the indicator to reconstruct sea-level we most desperately needed.

CONGRATULATIONS for all your hard work. You are now part of the elite group of scientists who have found basal and surface peats in Georgia. You are part of the team that was the FIRST to find it and the first to reconstruct sea level. We could not have done it without your dedication, hard work, and enthusiastic spirit.

We wish you all the best in any endeavor you pursue (maybe it will be earth science?) and we know you have the attitude, strength and courage to take on all life's challenges in your future. It was truly an honor and pleasure to work with all of you and teach you about this precious world we must protect.

Best wishes always and keep making this world a better place,

Candace Grand Pre

Co-PI Earthwatch SCAP team

SECTION ONE

Top highlight from the past field season

I think all SCAP team members would agree that the highlight of the trip was first sighting of that allusive Georgia marsh peat in our cores. It felt like New Year's Eve - first day of summer - first snow of the season - first new car - graduation from college - all wrapped into one day! It had been 12 days in the field working, coring, slogging equipment and battling the oppressive Georgia heat until we finally "struck gold (peat)". I remember that some students made up a "peat song and dance" and that always makes me laugh and happy to think about. In today's technology-driven society it is an incredible joy for an educator/scientist like me to see students get so happy about something as simple as decomposing plant matter in a salt marsh. It gives me hope that young people can still be awed by our natural world and it inspires in me a renewed interest in my research to make this world a better place. For me, there is nothing more rewarding than seeing young people become excited and inspired by the simple things in the world around them.

Non-technical overview of results

The primary goal (besides educating the students) was to collect data that can be used to reconstruct sea level change in Georgia over the last ~500 years. This is a multi-step process,

all of which we accomplished in two short weeks working together as a cohesive unit. They were:

- 1) Establish modern transects and collect surface samples on a marsh. We collected sediment from several stations along an elevational gradient across several marshes in Georgia. The data is used to look at changes in organic content, sand content, and foraminifera species as elevation changes across a marsh (from the water to the back fresh water forests). This allows us to establish a "modern analog" of what happens along a modern transect so that we can apply this information to what we find in our core data.
- 2) Teach the students how to survey and the principles behind the several survey approaches. Then use that information and allow the students to apply it so they can survey the elevation changes across a marsh surface and relate it to a benchmark elevation. This allows us to link the changes in data across the transect with specific elevations, as the organic content, grain sizes, and foraminifera are controlled by changes in elevation.
- 3) Collect short 50 cm cores along the modern transects and stain them to determine how deep foraminifera (our main sea-level indicator) can live in the modern environment. This information can drastically change the error on the final sea level constructions. The students collected the cores and then cut them into 1 cm patties and stained them so that the living foraminifera would be recognized as pink individuals under the microscope.
- 4) Teach the students how to use Russian-style human-powered coring equipment and how to recognize the changes they see in the sediment downcore. The main objective is to find continuous peat accumulation from the top down to the deepest depth possible and also to find basal peats (peat that is sitting on top of sand at the bottom of the core). The peat (and the foraminifera that are found in the peat) are the main proxies used to reconstruct sea level. We can go back to the lab and look at the foraminifera and date the peat to determine past sea levels, compare that to tide gauge data, and make predictions on how it will change in the future. We found all the peat we needed to achieve this goal.
- 5) We will begin to date and analyze the cores starting January 2011 and should have sea level constructions for this region by May 2011. This contributes to the total dataset for the whole east coast, lending information on how sea level change is different from place to place along the coast and help to identify which regions are most vulnerable to 21st century sea level change.

SECTION TWO: TECHNICAL REPORT

REPORTING AGAINST RESEARCH OBJECTIVES

Objective 1

The first objective is to study the modern environment of the chosen coastal field site.

Progress toward/against Objective 1

One must understand the unique relationship between the ecological and physical properties of the marsh (e.g. Gehrels, 2007) to create the site-specific model for future paleo-reconstructions of the environment through time (e.g. Scott and Medioli, 1978; Horton and Edwards, 2006; Kemp et al, 2009b). For example, each marsh has a unique tidal frame and sediment dynamics that control how the flora and fauna are distributed across the landscape (e.g. Kemp et al., 2009b). This relationship must be firmly understood so that it can be accurately implemented into the second objective.

Objective 2

We will use the model developed from Objective 1 and then collect and analyze fossil cores collected with the SCAP team on the marsh.

Progress toward/against Objective 2

Specifically we will be collecting cores to study the distribution of foraminifera in the geologic record. Benthic foraminifera are effective environmental indicators for modern and reconstructive studies because they are abundant both in the fossil record and in modern environments, and can tolerate extreme living and preservation conditions. Furthermore, benthic foraminifera are easily collected and prepared. Foraminifera are the most widely used proxy in modern studies relating unique assemblages to specific environments/conditions (e.g. Ellison and Nichols, 1970; Culver et al., 1996; Edwards et al, 2004 ; Horton and Edwards, 2006; Kemp et al., 2006). Thus, we can identify and map the foraminiferal assemblages in modern environments (Objective 1), to interpret paleoenvironments from fossil assemblages as Objective 2 (Gehrels et al., 2008; Kemp et al., 2009a).

Objective 3

To take the information and data gathered both in the modern (Objective 1) and fossil cores (Objective 2) to reconstruct a Holocene age (last 10,000 years) sea-level curve for the field site of interest (e.g., van de Plassche et al., 1998; Gehrels et al., 2008, Kemp et al, 2009a).

Progress toward/against Objective 3

We will be able to trace how sea level has changed at this specific field site through time and make inferences on how sea level at this site may change in the future.

Results and progress against objectives

Objective 1 and 2 were met successfully in the field with the SCAP students.

We also came up with an additional objective and collected 50cm short cores to test the idea of foraminifera being able to live at great depths on a salt-marsh. The findings of this could have a great impact of sea-level studies as the farther they can live below the surface the more error would have to be added to the sea level reconstruction. We believe we will find that foraminifera only live in the top few cm and we hope that this experiment will indicate confirm our hypothesis.

Objective 3 is the reconstruction of the data collected in the field and the production of a sea-level curve. We have already started to process the samples and we hope to have a final product by May 2011. We hope to compare our data to tide gauge data to validate our

conclusions so that we can confidently project the sea level trends for the future at this location.

Updates to objectives

We wish to include more laboratory analysis with the students on the Earthwatch project. The high cost and scientific value of our microscopes and the lack of insurance has made it difficult to transport lab-precision instruments into the field. In the past we have brought dissecting scopes and students could see some of the foraminifera (but only a few of the larger ones). They enjoyed this process very much, but it was limited in its scientific value as the scopes were not powerful enough to do real science. We hope to get a way to insure our lab microscopes so we can bring them to the field site and students can be part of processing the data after collection. We think this will greatly add to their understanding of the relevance of the data they collected in the field.

PARTNERSHIPS

Our only source of funding for these Earthwatch projects is Earthwatch and the Durfee Foundation. Without their contribution this field work would not be possible.

DISSEMINATION

This is from the New Jersey Earthwatch Project and sites the Earthwatch students and funding:

Vane, C.H., Harrison, I., Kim, A.W., Moss-Hayes, V., Vickers, B.P., and Horton, B.P., 2008, Status of organic pollutants in surface sediments of Barnegat Bay-Little Egg Harbor Estuary, New Jersey, USA: Marine Pollution Bulletin, v. 56, p. 1802-1808.

Research from both New Jersey field seasons went into: Engelhart, Simon, 2010, Ph.D. Dissertation. University of Pennsylvania

Grand Pre et al, Georgia foraminifera and sea level curves. This will be submitted to a journal by May 2011 and will thank all Earthwatch students and funding.

Mass media: broadcast production; film; TV, radio, print (newspaper/ magazine coverage); press releases; press conference;

One of the students this year wrote a journal article about her experiences with our Earthwatch expedition to Georgia Local for her local news paper and/or blog. I believe this student has submitted this article to Earthwatch.

Meetings and conferences: presentations/ lectures; conferences; workshops; training sessions; discussions; local community

We have presented lectures at the University of Pennsylvania on the data we collected and also about our experiences with Earthwatch.

We also present sea level data at many universities around the United States and also national and international meetings in the physical sciences.

DEVELOPING ENVIRONMENTAL LEADERS

The impact of our SCAP teams not only impacts the students directly but also provides undergraduate and graduate students at the University of Pennsylvania to participate in the project. They learn about the research, how to be leaders, how to engage students in the field and after-field discussions. We also visit the local educational and research institutions in the area, which benefits the students and us as the researchers. For instance, we spent two days working with the Skidaway Oceanographic Institute in Georgia, meeting their scientists and touring the facilities. This was an excellent opportunity for the students to see how the work they are learning can be applied in real life and we also made contacts with scientific colleagues that we will collaborate with in the future. We also visited a science center in Georgia where the students learned about the local biology and conservation efforts of the area. The leaders of this science center were very happy to have us and felt it was important that students from all over the country see what type of conservation possibilities and successes occur on the coast of Georgia. It was very obvious that the people we met in Georgia that work with conservation and educational institutes were very excited to see our SCAP students and this impacted the students greatly. They learned that conservation is not all lip-service and that there are researchers that would be very happy to work with these students in the future.

LONG TERM IMPACT OF PROJECT

Livelihood assets enhanced, restored or maintained

See the section "Developing Environmental Leaders" above. The students had many interactions with the people of Savannah, Georgia and we made many lasting contacts!